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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Application No.: To be Assigned  
Filing Date: Herewith  
Applicants: Bieler et al.  
Group Art Unit: To Be Assigned  
Examiner: To Be Assigned  
Title: METHODS FOR PRODUCING LEAD-FREE IN-SITU  
COMPOSITE SOLDER ALLOYS  
Attorney Docket: 6550-000013/COA

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Commissioner of Patents and Trademarks  
Washington, D.C. 20231

**PRELIMINARY AMENDMENT UNDER 37 C.F.R. §1.115**

Dear Sir:

Please enter the following amendments for the continuing application pursuant to 37

C.F.R. §1.53(b) filed herewith:

**Amendments to the Claims** begin on page 2 of this paper.

**Remarks** begin on page 9 of this paper.

### AMENDMENTS TO THE CLAIMS

Please amend the claims as follows. The following listing of claims will replace all prior versions and listing of claims in the application.

1. – 19. (Cancelled)
20. (New) A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:
  - (a) providing a mixture comprising the components of a eutectic or near-eutectic matrix solder and the components of an intermetallic component;
  - (b) heating said mixture so as to melt all components of said mixture forming a non-solid mixture; and
  - (c) cooling said non-solid mixture at a rate sufficiently fast so as to form a solder wherein intermetallic components having a particle size of less than about 10 microns are homogenously distributed throughout said matrix solder.
21. (New) A method of Claim 20, wherein said intermetallic component comprises a transition metal.
22. (New) A method of Claim 21, wherein said intermetallic component comprises a first row transition metal.
23. (New) A method of Claim 22, wherein said intermetallic component comprises a metal selected from the group consisting of nickel, iron, copper, and mixtures thereof.
24. (New) A method of Claim 23, wherein said intermetallic component comprises  $\text{Cu}_6\text{Sn}_5$ .

25. (New) A method of Claim 23, wherein said intermetallic component comprises  $\text{Ni}_3\text{Sn}_4$
26. (New) A method of Claim 23, wherein said intermetallic component comprises  $\text{FeSn}_2$ .
27. (New) A method of Claim 21, wherein said intermetallic component comprises a metal which is a component of said matrix solder.
28. (New) A method of Claim 20, wherein said matrix solder is a lead-free eutectic or near-eutectic solder.
29. (New) A method of Claim 28, wherein said matrix solder is a binary or ternary solder.
30. (New) A method of Claim 29, wherein said matrix solder is 96.5 Sn/3.5 Ag.
31. (New) A method according to Claim 20, wherein said intermetallic components are less than 5 microns in size.
32. (New) A method according to Claim 31, wherein intermetallic components having a particle size of less than about 5 microns are homogenously distributed throughout said matrix solder.
33. (New) A method according to Claim 32, wherein intermetallic components having a particle size of less than about 2 microns are homogenously distributed throughout said matrix solder.
34. (New) A method according to Claim 20, wherein said intermetallic component comprises from about 10% to about 20% by volume of said composite solder.

35. (New) A method of Claim 34, wherein said intermetallic component comprises about 20% by volume of said composite solder.
36. (New) A method according to Claim 20, additionally comprising, after said heating step (b) and prior to said cooling step (c), the steps of cooling said mixture to form a solid, and remelting said solid at a temperature sufficient to melt all components of said solid.
37. (New) A method according to Claim 20, wherein said cooling is at a rate of at least about 100° C/second.
38. (New) A method of Claim 20, wherein said cooling step comprises cooling by spat quenching, spray atomization, or by continuous casting into a solid form.

39. (New) A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:
- (a) providing a mixture comprising the components of said matrix solder and the components of said intermetallic component in amounts appropriate to form a solder having from about 5% to about 40% by volume of said intermetallic component;
  - (b) heating said mixture so as to melt all components of said mixture forming a non-solid mixture; and
  - (c) cooling said non-solid mixture at a rate sufficiently fast so as to form a solder wherein intermetallic components having a particle size of less than about 10 microns are homogenously distributed throughout said matrix solder.
40. (New) A method of Claim 39, wherein said intermetallic component comprises a first row transition metal.
41. (New) A method of Claim 40, wherein said intermetallic component comprises a metal selected from the group consisting of nickel, iron, copper, and mixtures thereof.
42. (New) A method of Claim 41, wherein said intermetallic component comprises a compound selected from the group consisting of  $\text{Cu}_6\text{Sn}_5$ ,  $\text{Ni}_3\text{Sn}_4$ ,  $\text{FeSn}_2$ , and mixtures thereof.
43. (New) A method of Claim 40, wherein said intermetallic component additionally comprises a metal which is a component of said matrix solder.
44. (New) A method of Claim 39, wherein said matrix solder is a eutectic or near-eutectic binary or ternary solder.
45. (New) A method of Claim 44, wherein said matrix solder is 96.5 Sn/3.5 Ag.

46. (New) A method of Claim 39, wherein said cooling step comprises cooling by spat quenching, spray atomization, or by continuous casting into a solid form.
47. (New) A method according to Claim 39, wherein said solder is lead-free.
48. (New) A method according to Claim 39, wherein said intermetallic components are less than 5 microns in size.
49. (New) A method according to Claim 48, wherein intermetallic components having a particle size of less than about 5 microns are homogenously distributed throughout said matrix solder.
50. (New) A method according to Claim 49, wherein intermetallic components having a particle size of less than about 2 microns are homogenously distributed throughout said matrix solder.
51. (New) A method according to Claim 39, wherein said intermetallic component comprises from about 10% to about 20% by volume of said composite solder.
52. (New) A method according to Claim 39, wherein said cooling is at a rate of at least about 100° C/second.
53. (New) A method according to Claim 39, additionally comprising, after said heating step (b) and prior to said cooling step (c), the steps of cooling said mixture to form a solid, and remelting said solid at a temperature sufficient to melt all components of said solid.

54. (New) A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:
- (a) providing a binary or ternary eutectic or near eutectic matrix solder;
  - (b) heating a mixture of said matrix solder with the components of a intermetallic component comprising a first row transition metal, at a temperature greater than the highest melting temperature of all of the individual components of said mixture so as to form a non-solid mixture; and
  - (c) rapidly cooling said non-solid mixture;
- wherein said composite solder comprises from about 5% to about 40% by volume of said intermetallic component, said intermetallic component comprises at least one element present in said matrix solder; and said intermetallic component comprises particles having a particle size of less than about 10 microns homogenously distributed throughout said composite solder.
55. (New) A method of Claim 54, wherein said particle size is less than 5 microns.
56. (New) A method of Claim 54, wherein said particle size is less than 2 microns.
57. (New) A method of Claim 54, wherein said intermetallic component comprises a metal selected from the group consisting of nickel, iron, copper, and mixtures thereof.
58. (New) A method of Claim 57, wherein said intermetallic component comprises a compound selected from the group consisting of  $\text{Cu}_6\text{Sn}_5$ ,  $\text{Ni}_3\text{Sn}_4$ ,  $\text{FeSn}_2$ , and mixtures thereof.
59. (New) A method of Claim 58, wherein said matrix solder is 96.5 Sn/3.5 Ag.

60. (New) A method of Claim 54, wherein said intermetallic particles comprises about 10% to about 20% by volume of said composite solder.
61. (New) A method of Claim 54, wherein said cooling step comprises cooling by splat quenching, spray atomization, or by continuous casting into a sold form.
62. (New) A method according to Claim 54, additionally comprising, after said heating step (b) and prior to said cooling step (c), the steps of cooling said mixture to form a solid, and remelting said solid at a temperature sufficient to melt all components of said solid.




**REMARKS**

The present invention application is being filed under 37 CFR 1.53(b) as a continuing application. Applicants respectfully request entry of amendments to Claims 1-62. After entry of this amendment, Claims 20-62 are pending.

Respectfully submitted,

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